

WHAT IS CLAIMED IS:

1                   1.       A tissue stabilizer for endoscopically stabilizing a target tissue  
2   within a patient's body, the tissue stabilizer comprising:  
3                   a shaft sized to allow insertion through an endoscopic cannula; and  
4                   a manipulable foot connected with the shaft, wherein the foot  
5   comprises a first toe portion and a second toe portion, the first and second toe portions  
6   being rotatably coupled with the shaft, each toe portion comprising at least one suction  
7   port to apply suction to the target tissue during stabilization, the first toe portion and  
8   second toe portion rotateable to a first arrangement wherein the foot is insertable through  
9   the endoscopic cannula.

1                   2.       A tissue stabilizer as in claim 1, wherein the first and second toe  
2   portions are rotatably coupled to the shaft by a split ball joint assembly, the split ball joint  
3   assembly allowing the first and second toe portions to rotate with respect to the shaft and  
4   with respect to each other.

1                   3.       A tissue stabilizer as in claim 2, wherein each toe portion  
2   comprises a ring mount.

1                   4.       A tissue stabilizer as in claim 3, wherein the split ball joint  
2   assembly further comprises a top ball shell and a bottom ball shell which together encase  
3   the ring mounts of the first and second toe portions to form a spherical split ball shell.

1                   5.       A tissue stabilizer as in claim 4, wherein the toe assembly further  
2   comprises a torsion spring to rotate the first toe portion and second toe portion to a second  
3   arrangement wherein the first toe portion and second toe portion are at least 8 mm apart.

1                   6.       A tissue stabilizer as in claim 1, wherein the foot further comprises  
2   an adjustable ankle coupling the first toe portion and the second toe portion to the shaft..

1                   7.       A tissue stabilizer as in claim 6, wherein the foot is moveable in six  
2   degrees of freedom relative to the shaft by adjusting the ankle.

1                   8.       A tissue stabilizer as in claim 6, wherein the ankle comprises an  
2   adjustable neck comprising a series of interlocking balls and intermediate socket rings.

1           9.     A tissue stabilizer as in claim 8, wherein each ball is independently  
2 rotateable against an adjacent ring to allow the neck to be adjusted.

1           10.    A tissue stabilizer as in claim 6, wherein the first toe portion is  
2 rotateably joined with the second toe portion by a spherical split ball assembly, and  
3 wherein the ankle comprises a housing within which the spherical split ball assembly is  
4 disposed.

1           11.    A tissue stabilizer as in claim 10, wherein the spherical split ball  
2 assembly is rotateable within the housing to adjust the position of the foot in relation to  
3 the shaft.

1           12.    A tissue stabilizer as in claim 1, further comprising at least one  
2 suction tube connectable with the at least one suction port.

1           13.    A tissue stabilizer as in claim 12, wherein the shaft comprises a  
2 suction lumen and the suction tube is insertable through the suction lumen.

1           14.    A tissue stabilizer as in claim 13, wherein the suction tube  
2 comprises a suction tip which is connectable with the at least one suction port by insertion  
3 into a suction tube receptacle.

1           15.    A tissue stabilizer as in claim 1, further comprising an irrigator.

1           16.    A tissue stabilizer as in claim 15, wherein the shaft comprises an  
2 irrigation lumen and the irrigator is insertable through the irrigation lumen.

1           17.    A tissue stabilizer for endoscopically stabilizing a target tissue  
2 within a patient's body, the tissue stabilizer comprising:

3               a shaft having a proximal end and a distal end, the shaft sized to allow  
4 insertion through an endoscopic cannula;

5               an adjustable ankle connected with the distal end of the shaft;

6               a manipulable foot connected with the ankle, wherein the foot comprises a  
7 first toe portion rotateably joined with a second toe portion, each toe portion comprising  
8 at least one suction port to apply suction to the target tissue during stabilization, the first

9 toe portion and second toe portion rotateable to a first arrangement wherein the foot is  
10 insertable through the endoscopic cannula; and  
11 a tension cable passing through the shaft wherein applying tension to the  
12 cable locks the ankle in position.

1 18. A tissue stabilizer as in claim 17, wherein the ankle comprises an  
2 adjustable neck comprising a series of interlocking balls and intermediate socket rings.

1 19. A tissue stabilizer as in claim 18, wherein each ball is  
2 independently rotateable against an adjacent ring to allow the neck to be adjusted.

1 20. A tissue stabilizer as in claim 18, wherein each ball and socket ring  
2 has a hollow core through which the tension cable extends.

1 21. A tissue stabilizer as in claim 20, wherein the balls and socket rings  
2 are arranged so that applying tension to the cable wedges the balls and socket rings  
3 together to lock the ankle in position by friction.

1 22. A tissue stabilizer as in claim 20, wherein the balls and socket rings  
2 are shaped so that applying tension to the cable causes at least one ball to apply a force to  
3 at least one socket ring at an angle of at least 60 degrees in relation to the cable.

1 23. A tissue stabilizer as in claim 17, wherein the first toe portion is  
2 rotateably joined with the second toe portion by a spherical split ball shell, and wherein  
3 the ankle comprises a housing within which the spherical split ball shell is disposed.

1 24. A tissue stabilizer as in claim 23, wherein the spherical split ball  
2 shell is rotateable within the housing to adjust the position of the foot in relation to the  
3 shaft.

1 25. A tissue stabilizer as in claim 23, wherein by applying tension to  
2 the cable the spherical split ball shell is locked within the housing so that the position of  
3 the foot is fixed in relation to the shaft.

1 26. A tissue stabilizer as in claim 25, wherein the tension cable  
2 comprises a locking ball disposed within the housing and wherein applying tension to the  
3 cable moves the housing so that the spherical split ball shell is locked within the housing.

1                   27.     A tissue stabilizer as in claim 17, further comprising a handle  
2     connected with the proximal end of the shaft, wherein rotation of the handle applies  
3     tension to the tension cable.

1                   28.     A tissue stabilizer as in claim 27, wherein the handle comprises  
2     ratchet pawls which lock the cable under tension.

1                   29.     A tissue stabilizer as in claim 27, wherein the handle comprises a  
2     release button which unlocks the cable from tension.

1                   30.     A system for endoscopically stabilizing a target tissue within a  
2     patient's body, the system comprising:  
3                   an endoscopic cannula; and  
4                   a tissue stabilizer comprising  
5                         a shaft sized to allow insertion through the endoscopic cannula, and  
6                         a manipulable foot connected with the shaft, wherein the foot  
7     comprises a first toe portion rotateably joined with a second toe portion, each toe portion  
8     comprising at least one suction port to apply suction to the target tissue during  
9     stabilization, the first toe portion and second toe portion rotateable to a first arrangement  
10    wherein the foot is insertable through the endoscopic cannula.

1                   31.     A system as in claim 30, further comprising an adjustable ankle  
2     disposed between the foot and the shaft.

1                   32.     A system as in claim 31, wherein the ankle comprises an adjustable  
2     neck comprising a series of interlocking balls and intermediate socket rings.

1                   33.     A system as in claim 32, wherein each ball is independently  
2     rotateable against an adjacent ring to allow the neck to be adjusted.

1                   34.     A system as in claim 30, wherein the first toe portion is rotateably  
2     joined with the second toe portion by a spherical split ball shell, and wherein the ankle  
3     comprises a housing within which the spherical split ball shell is disposed.

1                   35.     A system as in claim 34, wherein the spherical split ball shell is  
2     rotateable within the housing to adjust the position of the foot in relation to the shaft.

1           36.    A system as in claim 30, further comprising at least one suction  
2 tube connectable with the at least one suction port.

1           37.    A system as in claim 36, wherein the shaft comprises a suction  
2 lumen and the suction tube is insertable through the suction lumen.

1           38.    A system as in claim 36, wherein the suction tube comprises a  
2 suction tip which is connectable with the at least one suction port by insertion into a  
3 suction tube receptacle.

1           39.    A system as in claim 30, further comprising an irrigator.

1           40.    A system as in claim 39, wherein the shaft comprises an irrigation  
2 lumen and the irrigator is insertable through the irrigation lumen.

1           41.    A system as in claim 39, wherein the irrigator comprises an  
2 adjustable dispenser terminating in a spout portion.

1           42.    A system as in claim 41, wherein the dispenser comprises a  
2 plurality of beads coupled in a chain-like fashion.

1           43.    A method of endoscopically stabilizing a target tissue within a  
2 patient's body, the method comprising:

3                inserting a tissue stabilizer through an endoscopic cannula wherein the  
4 tissue stabilizer comprises  
5                a shaft having a proximal end and a distal end, and  
6                a manipulable foot connected with the shaft wherein the foot  
7 comprises at least two toe portions, each toe portion comprising at least one suction port;  
8                positioning the manipulable foot against the target tissue; and  
9                applying suction to the target tissue through the at least one suction port to  
10 stabilize the target tissue.

1           44.    The method as in claim 43, wherein the foot comprises a first toe  
2 portion rotateably joined with a second toe portion, said method further comprising  
3 rotating the first or second toe portions to a first arrangement wherein the foot is  
4 insertable through the endoscopic cannula.

1           45.     The method as in claim 43, wherein the tissue stabilizer further  
2 comprises an adjustable ankle disposed between the foot and the shaft, said method  
3 further comprising adjusting the ankle to adjust the position of the foot in relation to the  
4 shaft.

1           46.     The method as in claim 45, wherein the adjustable ankle comprises  
2 an adjustable neck comprising a series of interlocking balls and intermediate socket rings,  
3 said method further comprising rotating at least one ball against an adjacent ring

1           47.     The method as in claim 45, wherein the first toe portion is  
2 rotateably joined with the second toe portion by a spherical split ball shell and wherein  
3 the ankle comprises a housing within which the spherical split ball shell is disposed, said  
4 method further comprising rotating the spherical split ball shell within the housing to  
5 adjust the position of the foot in relation to the shaft.

1           48.     The method as in claim 43, wherein the shaft has a suction lumen  
2 therethrough, said method further comprising inserting a suction tube through the suction  
3 lumen.

1           49.     The method as in claim 48, wherein the suction tube has a suction  
2 tip, said method further comprising connecting the suction tip with the at least one suction  
3 port.

1           50.     The method as in claim 43, wherein the shaft has an irrigation  
2 lumen therethrough, said method further comprising inserting an irrigator through the  
3 irrigation lumen.

1           51.     The method as in claim 50, wherein the irrigator comprises an  
2 adjustable dispenser terminating in a spout portion, said method further comprising  
3 adjusting the dispenser so that the spout portion is directed at the target tissue.

1           52.     The method as in claim 51, further comprising supplying a fluid to  
2 the irrigator so that the fluid exits the spout portion.

1           53.     A method of endoscopically stabilizing a target tissue within a  
2 patient's body, the method comprising:

3 inserting a tissue stabilizer through an endoscopic cannula wherein the  
4 tissue stabilizer comprises  
5 a shaft having a proximal end and a distal end,  
6 an adjustable ankle connected with the distal end of the shaft,  
7 a manipulable foot connected with the shaft wherein the foot  
8 comprises at least two toe portions, each toe portion comprising at least one suction port,  
9 and  
10 a tension cable passing through the shaft wherein applying tension  
11 to the cable locks the ankle in position;  
12 positioning the manipulable foot against the target tissue; and  
13 applying suction to the target tissue through the at least one suction port to  
14 stabilize the target tissue.

1 54. A method as in claim 53, further comprising applying tension to  
2 the cable.

1 55. A method as in claim 54, wherein the ankle comprises an  
2 adjustable neck comprising a series of interlocking balls and intermediate socket rings,  
3 each ball and socket ring having a hollow core through which the tension cable extends,  
4 and wherein applying tension to the cable wedges the balls and socket rings together to  
5 lock the ankle in position by friction.

1 56. A method as in claim 54, wherein the foot comprises a first toe  
2 portion rotateably joined with a second toe portion by a spherical split ball shell and  
3 wherein the ankle comprises a housing within which the spherical split ball shell is  
4 disposed, and wherein applying tension to the cable locks the spherical split ball shell  
5 within the housing so that the position of the foot is fixed in relation to the shaft.

1 57. A method as in claim 56, wherein the tension cable comprises a  
2 locking ball disposed within the housing and wherein applying tension to the cable moves  
3 the housing so that the spherical split ball shell is locked within the housing.

1 58. A method as in claim 54, wherein the tissue stabilizer further  
2 comprises a handle connected with the proximal end of the shaft, and wherein applying  
3 tension to the cable includes rotating the handle.

1           59.     A method as in claim 58, wherein the handle further comprises  
2 ratchet pawls, said method further comprising locking the cable under tension with the  
3 use of the ratchet pawls.

1           60.     A method as in claim 59, wherein the handle further comprises a  
2 release button, said method further comprising depressing the release button to unlock the  
3 cable from tension.

1           61.     A vessel occlusion device for controlling blood flow in a blood  
2 vessel, the device comprising:  
3                 a plate-like body having a bore intersecting a radial slot;  
4                 a flexible member having a free end and fixed end, wherein the fixed end  
5 is fixedly attached to the body and wherein the flexible member has a diameter sized so  
6 that the member is frictionally held in the radial slot upon insertion of the free end into  
7 the radial slot.

1           62.     A device as in claim 61, wherein the flexible member comprises  
2 silicone tubing.

1           63.     A device as in claim 61, wherein the plate-like body has a length of  
2 approximately 7.9 mm and a width of approximately 2.5 mm.

1           64.     A device as in claim 63, wherein the plate-like body has a depth of  
2 approximately 1.3 mm.

1           65.     A device as in claim 63, wherein the bore has a diameter of  
2 approximately 1.3 mm and a slot width of approximately 0.25 mm.

1           66.     A device as in claim 65, wherein the flexible member has an outer  
2 diameter of approximately 0.05 inches.

1           67.     A method of endoscopically preparing a blood vessel associated  
2 with a target tissue for a surgical procedure, said method comprising:  
3                 endoscopically positioning a tissue stabilizer at a first location against the  
4 target tissue to stabilize the tissue;



5 endoscopically positioning at least one vessel occlusion device around the  
6 blood vessel to restrict blood flow therethrough;  
7 removing the tissue stabilizer from the target tissue while the vessel  
8 occlusion device remains in place.

1 68. A method as in claim 67, further comprising repositioning the  
2 tissue stabilizer to a second location against the target tissue while the vessel occlusion  
3 device remains in place.

1 69. A method as in claim 67, wherein the tissue stabilizer comprises a  
2 shaft sized to allow insertion through an endoscopic cannula and a manipulable foot  
3 connected with the shaft, wherein the foot comprises a first toe portion rotateably joined  
4 with a second toe portion, the first toe portion and second toe portion rotateable to a first  
5 arrangement wherein the foot is insertable through the endoscopic cannula, and wherein  
6 endoscopically positioning the tissue stabilizer comprises positioning the foot against the  
7 target tissue.

1 70. A method as in claim 67, wherein the vessel occlusion device  
2 comprises a plate-like body having a bore intersecting a radial slot and a flexible member  
3 having a free end and fixed end, wherein the fixed end is fixedly attached to the body, and  
4 wherein endoscopically positioning at least one vessel occlusion device comprises  
5 passing the free end of the flexible member around the blood vessel and into the radial  
6 slot so that the member is frictionally held.

1 71. A method of controlling blood flow in a blood vessel, said method  
2 comprising:

3 providing a vessel occlusion device comprising

4 a plate-like body having a bore intersecting a radial slot, and

5 a flexible member having a free end and fixed end, wherein the  
6 fixed end is fixedly attached to the body;

7 passing the free end of the flexible member around the blood vessel and  
8 through the bore so that the blood vessel is encircled by the flexible member and the  
9 plate-like body;

10 pulling the flexible member so that the blood flow is restricted in the blood  
11 vessel; and

12 sliding the flexible member into the radial slot so that the member is  
13 frictionally held.

1 72. A method as in claim 71, further comprising sliding the flexible  
2 member out of the radial slot to release the flexible member so that blood flow through  
3 the blood vessel is increased.

1 73. A method as in claim 71, further comprising adjusting the position  
2 of the flexible member by sliding the flexible member out of the radial slot and re-sliding  
3 the flexible member into the radial slot.

1 74. A method as in claim 71, further comprising:  
2 providing a tissue stabilizer for endoscopically stabilizing a target tissue  
3 within or upon which the blood vessel is disposed; and  
4 positioning the tissue stabilizer against the target tissue to stabilize the  
5 tissue.

1 75. A tissue stabilizer for endoscopically stabilizing a target tissue  
2 within a patient's body, the tissue stabilizer comprising:  
3 a shaft sized to allow insertion through an endoscopic cannula; and  
4 a manipulable foot connected with the shaft, wherein the foot comprises a  
5 first toe portion and a second toe portion,  
6 the first and second toe portions being rotatably coupled with the shaft by  
7 a rotating joint assembly, the rotating joint assembly providing that at least one of the first  
8 and second toe portions are rotatable with respect to the shaft and providing that the first  
9 and second toe portions are rotatable with respect to each other,  
10 the first toe portion and second toe portion rotatable to at least a first toe  
11 arrangement wherein the foot is insertable through the endoscopic cannula.

1 76. A tissue stabilizer as in claim 75, wherein each toe portion  
2 comprises at least one suction port configured so as to apply suction to the target tissue  
3 during stabilization.

1 77. A tissue stabilizer as in claim 75, wherein the first toe arrangement  
2 is configured so that the first toe portion lies overlapping at least a portion of the second  
3 toe portion.

1           78.     A tissue stabilizer as in claim 77, wherein the rotating joint  
2     assembly comprises a first a pivotal joint and a second pivotal joint, the first and second  
3     pivotal joints being coupled to the first and second toe portions respectively.

1           79.     A tissue stabilizer as in claim 77, wherein the rotating joint  
2     assembly comprises a split ball joint assembly.

1           80.     A tissue stabilizer as in claim 79, wherein the split ball joint  
2     assembly further comprises a first split ball portion coupled to the first toe portion, and a  
3     second split ball portion coupled to the first toe portion, the first and second split ball  
4     portions being disposed adjacent one another so as to define at least a portion of a  
5     generally spherical ball assembly.

1           81.     A tissue stabilizer as in claim 80, wherein each toe portion  
2     comprises a ring mount.

1           82.     A tissue stabilizer as in claim 81, wherein the first split ball portion  
2     is disposed adjacent the ring mount of the first toe, and the second split ball portion is  
3     disposed adjacent the ring mount of the second toe, the first and second split ball portions  
4     together encase the ring mounts of the first and second toe portions.

1           83.     A tissue stabilizer as in claim 75, further comprising an adjustable  
2     ankle disposed between the foot and the shaft and coupling the foot to the shaft.

1           84.     A tissue stabilizer as in claim 75, further comprising an irrigator.

1           85.     A tissue stabilizer as in claim 75, further comprising at least one  
2     suction tube connectable with the at least one suction port.

1           86.     A tissue stabilizer as in claim 75, further comprising a tension  
2     cable passing through the shaft wherein applying tension to the cable locks the foot in  
3     position with respect to the shaft and locks the toe portions in position with respect to one  
4     another.

1           87.     A tissue stabilizer as in claim 75, further comprising at least one  
2     cleat device mounted to a portion of the foot, the cleat device being configured to  
3     releasable hold a flexible elongate member for vessel occlusion.

88. A joint assembly for adjustably supporting a portion of an endoscopic surgical instrument, comprising:  
at least one ball member having a generally axially symmetrical convex external surface portion;  
at least one socket member having a generally axially symmetrical concave internal surface portion; and  
the ball member mating with the socket member by contact of the convex surface portion with the concave surface portion.

89. The joint assembly of claim 88, wherein the convex surface portion of the ball member has a curvature in the axial direction which is substantially greater than the curvature in the axial direction of the concave surface portion of the socket member, the contact between the convex portion and the concave portion defining a zone of contact spaced radially outward from the axis of the socket portion.

90. The joint assembly of claim 89, wherein the convex surface portion of the ball member has a generally spherical contour, and the concave surface portion of the socket member having a generally conical contour.

91. The joint assembly of claim 90, wherein each of the ball member and the socket member have a core lumen, the core lumen of the ball member being in communication with the core lumen of the socket member, the zone of contact being spaced substantially radially outward from the core lumen of the ball member.

92. The joint assembly of claim 91, further comprising a compression mechanism configured to selectably urge the ball member against the socket member, so as to produce a selectable frictional engagement of the ball member with the socket member to provide resistance to rotation of the ball member with respect to the socket member.

93. The joint assembly of claim 92, wherein the compression mechanism includes a flexible tension member passing through each of the core lumens, the tension element coupling at a first end to the ball member and at a second end to the socket member, the compression mechanism providing for selectably retracting the tension member so as to urge the ball member against the socket member.

1           94.     The joint assembly of claim 89, wherein the joint assembly  
2 comprises a plurality of interconnected joint members, each joint member including one  
3 of said at least one ball members and one of said at least one socket members, the  
4 plurality of joint members being arranged in chain like fashion by the engagement of ball  
5 members with adjacent socket members.

1           95.     A irrigator assembly for an for an endoscopic surgical instrument  
2 for supplying or removing fluids from a surgical site, comprising  
3           an adjustable dispenser member including a plurality of interlocking beads  
4 coupled in a chain-like fashion;  
5           the beads each having a core lumen communicating with the core lumen of  
6 each adjacent bead, so as to define a conduit for the passage of fluid.

1           96.     The irrigator assembly of claim 95, wherein  
2 at least one bead includes a socket portion and a ball portion;  
3 the ball portion engaging a corresponding socket portion of a first adjacent  
4 bead; and  
5 the socket portion engaging a ball portion of a second adjacent bead.

1           97.     The irrigator assembly of claim 96, wherein the engagement of  
2 each ball portion with each socket portion is configured to produce a substantial non-  
3 locking frictional interaction, so as to resist rotation of the at least one bead with respect  
4 to adjacent beads, to provide for the stable adjustment of the dispenser configuration.

1           98.     The irrigator assembly of claim 97, wherein the dispenser member  
2 terminates in a spout member in communication with the core lumens, the irrigator being  
3 connectable to a fluid supply for causing the flow of a fluid through the core lumens and  
4 the spout member to the surgical site.

1           99.     The irrigator assembly of claim 98, wherein the dispenser member  
2 terminates in a intake member in communication with the core lumens, the irrigator being  
3 connectable to a suction source for causing the flow of a fluid through the core lumens  
4 and the intake member away from the surgical site.

1                   100. A method of endoscopically stabilizing a target tissue within a  
2 patient's body, the method comprising:  
3                   inserting a tissue stabilizer through an endoscopic cannula wherein the  
4 tissue stabilizer comprises  
5                   a shaft having a proximal end and a distal end, and  
6                   a manipulable foot connected with the shaft wherein the foot  
7 comprises at least two toe portions; and  
8                   positioning the tissue stabilizer with the use of a robotically operated  
9 surgical instrument from within the patient's body.

1                   101. A method as in claim 100, wherein positioning the tissue stabilizer  
2 comprises positioning the manipulable foot against the target tissue.

1                   102. A method as in claim 101, wherein positioning the manipulable  
2 foot comprises grasping at least one of the toe portions with the robotically operated  
3 surgical instrument.